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Predictors of ICT Integration in Teaching: The Role of Teachers' ICT Self-Efficacy and ICT Infrastructure

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Abstract: Information and Communication Technologies (ICT) have the potential to enhance teaching and learning and influence the development of students' digital competencies. However, harnessing the potential of ICT in a way that contributes to positive student outcomes poses a challenge for many teachers. The question arises as to whether providing adequate ICT infrastructure in schools facilitates access and, therefore, the use of ICT in teaching. Additionally, it is significant to examine the role of teachers' knowledge and beliefs in this context. Therefore, this study aimed to explore the relationship between teachers' perception of ICT infrastructure in schools, ICT self-efficacy, and ICT integration. The study involved 590 teachers from primary and secondary schools in Serbia. By conducting multiple regression analysis, significant effects of teachers' ICT self-efficacy and perception of available ICT equipment in schools on the use of ICT in teaching activities were obtained. ICT self-efficacy explains the criterion variable to a greater extent. The paper concludes with recommendations for future research and practice.

Keywords: *Information and Communication Technologies (ICT), teachers' ICT self-efficacy, ICT infrastructure, ICT integration, teachers*

Introduction

The digitalization of school systems presents numerous challenges worldwide (Drossel, Eickelmann and Vennemann, 2020). Educational technologies are attributed with the potential to enhance the quality of teaching and, consequently, student learning (Chauhan, 2017; OECD, 2015). Technology can impact specific aspects of teaching quality, such as student cognitive engagement during learning, providing personalized feedback, and adapting teaching to individual students (Kunter, Klusmann, Baumert, Richter, Voss and Hachfeld, 2013). Therefore, it is important to promote teaching practices focused on students rather than conventional content-focused practices (Tondeur, Pareja Roblin, van Braak, Voogt and Prestridge, 2017).

Furthermore, fostering students' digital literacy is considered crucial for future education and professional advancement (Geisinger, 2016). In this context, numerous national and international initiatives have been launched. The European Commission emphasizes that every citizen must have digital competencies to participate in 21st-century society (Carretero, Vuorikari and Punie, 2017). Regarding factors that support or hinder teachers' use of technology in teaching, one possibility is distinguishing between material factors (e.g., school resources) and non-material factors related to teacher variables (Eickelmann, 2011).

Technological innovation involves another significantly challenging aspect compared to other educational innovations related to the required financial investments (Lomos, Luyten and Tieck, 2023). Despite the observed high availability of digital devices per student and the quality of ICT resources, in some countries, the use of ICT in teaching practice remains low, as found in the ICILS 2018 study (Fraillon, Ainley, Schulz, Friedman and Duckworth, 2019). The quality of technology integration concerns teachers' motivational factors (Backfisch, Lachner, Stürmer and Scheiter, 2021; Taimalu and Luik, 2019;

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Vongkulluksn, Xie and Bowman, 2018). Previous research indicates a positive correlation between technology integration and teachers' self-efficacy in using technology in the classroom (Taimalu and Luik, 2019). At the same time, beliefs about the usefulness of technology for teaching purposes have been linked to the quantity and quality of technology use (Backfisch et al., 2021). The Republic of Serbia also participates in the international ICILS 2023 study, which will provide data on predictors of ICT use in the national education system (Institute for the Evaluation of the Quality of Education and Upbringing, 2023).

ICT Infrastructure

ICT infrastructure is a necessary condition for teachers to use ICT and refers to computers, digital tools, and a well-functioning internet connection (Lomos et al., 2023). Therefore, ICT infrastructure in schools is largely determined by the ICT equipment itself and the available technical-pedagogical support, which is an essential characteristic for the successful implementation of new technologies in teaching and learning processes (Gerick, Eickelmann and Bos 2017; Vanderlinde and van Braak, 2010).

However, countries with educational systems characterized by a high level of available ICT resources for teaching and learning do not necessarily have a high level of ICT use by teachers in the classroom. On the other hand, some countries, such as Denmark and Finland, have both a high level of available ICT resources and a high level of ICT use by teachers. Therefore, even in educational systems where ICT infrastructure and digital learning materials have been made available (Gil-Flores, Rodríguez-Santero and Torres-Gordillo, 2017), teachers still differ in the extent to which they use these resources in their teaching practice (Lomos et al., 2023).

Many studies have investigated factors related to the use of ICT in the classroom (Lomos et al., 2023; Spiteri and Chang Rundgren, 2020). The primary obstacle to teachers' use of ICT for learning and e-learning relates to ICT infrastructure, especially in educational contexts in development (Auma and Achieng, 2020; Lomos et al., 2023). From the teachers' perspective, "equipment remains the biggest barrier to ICT use" (European Commission, 2013, p. 71). Teachers need access to necessary technology (Eickelmann, 2011), and beyond that, they must have the time and opportunities to utilize this infrastructure in their practice. If appropriate ICT infrastructure is provided, teachers are more likely to use educational technology (Kundu, Bej and Dey, 2020).

Several studies (Lomos et al., 2023; Kundu, Bej and Dey, 2021; Shiue, 2007) clearly demonstrate that ICT infrastructure can be a factor influencing teachers' ability to apply technology pedagogically. This finding is further supported by various studies identifying ICT infrastructure in schools as a key factor in its use for learning purposes (Drossel, Eickelmann and Gerick, 2017; Petko, 2012). In explaining the use of ICT in education, providing ICT equipment constitutes a starting point in educational policies. The first (emerging) phase involves introducing infrastructure. In the second (application) phase, teachers apply technology in their ongoing teaching-learning processes. In the third (infusion) phase, teachers will start using technology in various innovative ways in teaching (Gil-Flores et al., 2017).

ICT Teacher Self-Efficacy

For the teaching profession, "teacher's efficacy belief is a judgment of his or her capabilities to bring about desired outcomes of student engagement and learning, even among those students who may be difficult or unmotivated" (Tschannen-Moran and Hoy, 2001, p. 783). In other words, teacher self-efficacy is defined as "teachers' beliefs that they are capable of carrying out good teaching in the classroom" (Christophersen, Elstad, Turmo and Solhaug, 2016, p. 241). Bandura (Bandura, 1997) emphasizes that self-efficacy beliefs are a strong motivational factor. Self-efficacy beliefs can become self-fulfilling prophecies in a specific domain and primarily influence individuals' motivation levels, persistence, and cognitive processes. Expectations of efficacy regarding task accomplishment affect individuals' performances, increasing their task performance levels. In addition to professional knowledge and skills, the perceived efficacy of teachers in performing tasks in different work domains plays a significant role (Skaalvik and Skaalvik, 2007).

Pedagogical use of technology may require specific types of teacher self-efficacy. Bandura (Bandura, 1997) highlights that self-efficacy is not a global trait but is domain-specific and context-specific. Several researchers (Wang, Ertmer and Newby, 2004; Anderson and Maninger, 2007) define the construct of self-efficacy in the domain of technology integration as teachers' belief in their ability to effectively use technology in teaching. Moreover, the literature indicates that ICT teacher self-efficacy is a

multidimensional construct. Scherer and Siddiq (2015) point out that, although highly correlated, computer self-efficacy in basic and advanced ICT skills and self-efficacy in using computers for instructional purposes represent separate constructs. One way to interpret this positive association is teachers' overall perception of their ICT skills (general ICT self-efficacy), which is necessary but insufficient to determine the determinants of ICT use for instructional purposes (Hatlevik and Hatlevik, 2018).

Hammond, Reynolds and Ingram (2011) found that lower levels of self-efficacy are reasons for less frequent ICT use. Teachers with low self-efficacy may fear technological innovations and may show resistance to computer use (Holden and Rada, 2011). On the other hand, teachers with higher levels of ICT self-efficacy have higher confidence levels in using ICT (Fanni, Rega and Cantoni, 2013) and are more likely to use ICT devices more frequently and experience less anxiety related to using these tools (Sam, Othman and Nordin, 2005). They are more open to new ideas and willing to experiment with new methods. Research even suggests that teachers who perceive higher levels of self-efficacy regarding ICT are more likely to use constructivist teaching methods more frequently (Teo, Chai, Hung and Lee, 2008).

A high level of computer self-efficacy contributes to positive attitudes toward computer-supported education (Yeşilyurt, Ulaş and Akan, 2016). Among other variables, scientists see teachers' ICT competence as a relevant condition for promoting the complex process of integrating ICT for instructional purposes (Vanderlinde and van Braak, 2010). Self-efficacy in using technology is significantly associated with perceived usefulness and ease of use (Scherer, Siddiq and Tondeur, 2019). Moreover, a positive relationship has been established between self-efficacy in using digital tools and ICT use for instructional purposes (Hatlevik, 2017).

Research objective

The availability of ICT resources in schools represents a direct determinant of users' acceptance regarding technology utilization. According to the Technology Acceptance Model (Venkatesh, Morris, Davis and Davis, 2003), resource availability facilitates technology use. Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur and Sendurur (2012) describe two types of barriers related to the pedagogical use of technology in teaching. Second-order barriers concerning teachers' professional beliefs require fundamental changes. First-order barriers relate to missing or inadequately provided resources such as equipment, training, and support. These are usually barriers that can be easily overcome through financial investments. Therefore, there is a need to understand the effects of different variables regarding the use of ICT in teaching practice. With all this in mind, the following research questions are posed:

1. Is ICT equipment a significant predictor of ICT use by teachers in the Serbian school context?
2. Is ICT teacher self-efficacy significantly associated with the use of ICT in teaching practice?
3. What is the most significant predictor of ICT use in teaching, after controlling for sociodemographic variables?

Materials and Methods

The research included 590 Serbian teachers from the territory of AP Vojvodina, specifically those working in urban schools. The sample consisted of 80.7% women, aged between 23 and 65 years (M = 46.46, SD = 9.31). About a quarter of them have up to 10 years of teaching experience (25.9%) and between 11 and 20 years (27.8%), while about half of the sample consists of teachers with over 20 years of teaching experience (46.3%). Slightly more teachers (56.6%) come from primary schools, while the remaining 43.4% teach in high schools or vocational schools. School principals' consent was obtained for conducting the research, and the questionnaire was distributed to teachers. Participation in the research was voluntary and anonymous.

The instruments used in foreign studies were carefully translated and adapted to the context of the education system in the Republic of Serbia. The ICT Teacher Self-Efficacy Scale is authored by Vanderlinde and van Braak (2010). An example item is: "I have enough organizational skills to use ICT in teaching." The reliability of the scale measured by Cronbach's alpha coefficient is .939, which indicates that it is a reliable measure of teachers' ICT self-efficacy.The following scale related to the use of ICT in teaching is the translated scale (Cheng, Lu, Xie, and Vongkulluksn, 2020) consisting of seven statements, with an example item being: "I use ICT to present teaching content."The Cronbach's alpha for the ICT use in

teaching is high and is .924, suggesting that the scale is a reliable measure of the use of digital technologies in the teaching process.The availability of ICT equipment in schools was assessed using questions from the Senić Ružić questionnaire (2019). These questions relate to the types of ICT used in the school (e.g., computer labs, internet). The frequency of using specific ICT equipment was measured using a five-point scale. The alpha coefficient value for the Availability of ICT equipment scale is .703, indicating an acceptable level of scale reliability.

Results

Hierarchical multiple regression was conducted to explore the relationship between factors considered significant in the context of ICT integration in teaching, including sociodemographic characteristics, teachers' perceptions of ICT infrastructure, and ICT self-efficacy. This analysis aims to determine the combined significance of these variables in explaining the outcome, as well as to individually assess their contributions. The regression models were constructed using the R program. Semi-partial correlation squared was used to measure the unique variance in the outcome explained by each predictor. We tested various regression models separately to understand the effects and variance explained by different factors related to ICT integration in teaching. Initially, we tested a demographics model, including only demographic characteristics, which were kept as control variables across all subsequent models. Next, an ICT infrastructure model was introduced, followed by the inclusion of teachers' self-efficacy in ICT in the third block of the hierarchical regression analysis.

Descriptive Statistics

Table 1 displays descriptive statistical indicators, including means, standard deviations, and indicators of distribution flatness and skewness, as well as correlations among the variables under investigation. All three variables exhibit moderate positive correlations (ranging from .288 to .455). Teachers achieve mean scores close to the theoretical average on measures of ICT use in teaching and assessment of equipment availability in the schools where they work, while the mean score on the assessment of ICT teacher self-efficacy is slightly above the theoretical average. The distribution flatness and skewness indicators values suggest that the data for the three variables examined do not deviate from normal distribution.

Table 1. *Descriptive statistics and correlations among variables*

	1.	2.	3.
1. ICT integration in teaching	1		
2. Availability of ICT infrastructure in schools	.392**	1	
3. ICT Self-efficacy	.455**	.288**	1
M	3.290	1.993	3.904
SD	.889	.734	.824
Skewness	-.206	-.065	-.892
Kurtozis	-.280	-.086	1.236

Note: M = mean; SD = standard deviation
***p < .01; *p < .05.*

Regression Model

To examine the predictive contribution of equipment availability and self-efficacy in the context of ICT in explaining technology use in teaching, hierarchical regression analysis was conducted in three blocks (Table 2). In the first block, control sociodemographic variables were introduced, including gender, age, years of experience, and type of school where teachers teach. The first block of variables explains only 3.5% of the outcome variance (R2 = .035; adjusted R2 = .027), with significant predictive contributions from gender (β = -.097, p=.019) and age (β = -.135, p=.039). Male teachers perceive more frequent ICT use in schools compared to female teachers, while ICT use in teaching decreases with teacher age.

In the second block of hierarchical regression analysis, the variable measuring equipment availability in schools was introduced. The second block of variables explains 19.3% of the outcome variance

(R2 = .193; adjusted R2 = .185), with significant predictive contributions to ICT use in teaching from the type of school (β = .118, p =.002) and equipment availability (β = .403, p < .001). Teachers teaching in high schools report more frequent ICT use in teaching than those employed in primary schools. Equipment availability is a significant predictor of ICT use in teaching, even after controlling for sociodemographic variables. Teachers who perceive equipment availability in their workplace as higher are more likely to report frequent ICT use in teaching.

In the third block of hierarchical regression analysis, teachers' self-efficacy in the context of ICT was introduced into the model. The third block of variables explains 29.4% of the outcome variance (R2 = .294; adjusted R2 = .285), with significant predictors of ICT use in teaching, including school type (β = .090, p= .014), equipment availability (β = .302, p < .001), and teachers' self-efficacy in the context of ICT (β = .345, p < .001). Teachers' self-efficacy in the context of ICT is a significant predictor of ICT use in teaching even after controlling for sociodemographic variables and above equipment availability assessment in schools. With an increase in teachers' self-efficacy in the context of ICT, ICT use in teaching also increases.

Table 2. *Results of hierarchical regression analysis*

	R	ΔR^2	B	S.E.	Partial r	B	P
Block 1: sociodemographic variables	.187**	.035**					
Gender (rg = male)			-.219	.093	-.097	-.097	.019
Age			-.013	.006	-.085	-.135	.039
Teaching experience $_{11\text{-}20\ years}$ (rg = less than 10 years)			.045	.112	.016	.023	.691
Teaching experience $_{20\ years\ and\ more}$ (rg = less than 10 years)			.012	.142	.003	.007	.935
School type (rg = primary school)			.099	.075	.054	.055	.189
Block 2: availability of ICT infrastructure	.439**	.158**					
Gender (rg = male)			-.149	.085	-.072	-.066	.081
Age			-.011	.006	-.081	-.116	.051
Teaching experience $_{11\text{-}20\ years}$ (rg = less than 10 years)			.013	.103	.005	.006	.903
Teaching experience $_{20\ years\ and\ more}$ (rg = less than 10 years)			-.010	.130	-.003	-.006	.939
School type (rg = primary school)			.212	.070	.125	.118	.002
Availability of ICT infrastructure			.488	.046	.405	.403	.000
Block 3: ICT self-efficacy	.542**	.101**					
Gender (rg = male)			-.070	.080	-.036	-.031	.385
Age			-.007	.005	-.055	-.074	.183
Teaching experience $_{11\text{-}20\ years}$ (rg = less than 10 years)			.027	.096	.012	.014	.781
Teaching experience $_{20\ years\ and\ more}$ (rg = less than 10 years)			.059	.122	.020	.033	.628
School type (rg = primary school)			.161	.065	.101	.090	.014
Availability of ICT infrastructure			.366	.045	.320	.302	.000
ICT self-efficacy			.373	.041	.353	.345	.000

Note: rg = reference group;
**p < .01; *p < .05.

Discussions

Our findings enrich the understanding of key factors regarding the implementation of ICT in schools. The research focuses on the ongoing debate about first-order barriers (insufficient resources) and second-order barriers (teachers' beliefs) that hinder the use of ICT. The international contribution of this research lies in the detailed analysis of factors that support the pedagogical use of ICT. Comprehensive theoretical framework regarding factors that influence ICT integration is currently lacking, this empirical study sheds light on the specific contributions of factors at the school level, ICT infrastructure, and teacher-related factors, including ICT self-efficacy. Although not conducted on a representative sample of teachers at the level of the Republic of Serbia, the findings of this study provide a valuable contribution and allow for comparison with the results obtained in the ICILS 2023 testing.

Firstly, we highlight the results of the descriptive analysis. A moderately positive correlation was documented between teachers' ICT self-efficacy and ICT use in teaching (r = .455), while the correlation value for the predictor of ICT equipment availability in schools was slightly lower at (r = .398). All three

variables show moderate positive correlations (ranging from .288 to .455). Teachers achieve the highest average score in assessing self-efficacy in the context of ICT. This score is higher than the mean score on the ICT use scale, which is consistent with Bandura's finding that self-beliefs of efficacy can be higher than actual abilities (Bandura, 1997).

We tested different regression models to identify the individual effects of the examined variables. Specifically, we first tested a model that includes only teachers' demographic characteristics. These demographic variables were retained in all subsequent tested models. In the first regression model, teachers' sociodemographic variables were introduced as predictors of ICT use in teaching, including gender, age, years of experience, and type of school. These variables explain only 3.5% of the outcome variance, while significant predictive contributions to ICT use in teaching are observed from gender and age. Male teachers apply ICT in schools more frequently than female teachers, while teacher age is negatively associated with ICT use in teaching. This finding may be explained by the generally more positive attitudes of men towards technology compared to women and the tendency for female teachers to experience greater anxiety about technology use than male teachers (Cai, Fan and Du, 2017). However, Ferreira (2017) argues that these differences may stem from deeply ingrained gender stereotypes and preconceived ideas about how women and men use (or are expected to use) technology. A more careful interpretation of the results reveals that the surveyed teachers, on the whole, perceive ICT use positively (Pozas and Letzel, 2023). The finding regarding the effect of teacher age on ICT use is consistent with the results of other studies that have shown higher use among relatively young teachers (Guillén-Gámez, Lugones and Mayorga-Fernández, 2019; Scherer, Siddiq and Teo, 2015). Younger teachers tend to be more enthusiastic about using ICT (Mahdi and Al-Dera, 2013), while older teachers feel less confident using computers. Also, many older teachers have had no initial computer education and, as a result, need additional training (Becta, 2004). Recent research has identified a statistically significant effect of a teacher's age related to the school's vision of the importance of ICT, suggesting a possible interaction between age and teachers' attitudes toward the usefulness of ICT (Lomos et al., 2023).

In the second regression model, the availability of ICT equipment in schools was introduced as a variable. This model explains 19.3% of the variance in ICT use, and significant effects on ICT use in teaching are observed for equipment availability and school type. High school teachers demonstrate a more frequent ICT use in teaching than those employed in primary schools. Equipment availability is a significant predictor of ICT use in teaching, even after controlling for sociodemographic variables. This finding is consistent with several previous studies (Vanderlinde and van Braak, 2010; Kundu et al., 2020) that have found infrastructure to be an important factor in ICT use. Lomos and associates (Lomos et al., 2023) found a small but significant effect of available resources on teachers' ICT use in teaching. Teachers' frequent use of ICT in the classroom is less likely when there are problems with resource availability in schools (Gil-Flores et al., 2017). However, the main predictors of ICT use can vary from country to country due to differences in economic development, educational tradition, and cultural background. For example, some developed countries like the Netherlands pay little attention to the impact of school ICT infrastructure (Drent and Meelissen, 2007), while in some developing countries, the lack of infrastructure is a key issue for teachers' ICT use (Chen, Zhou, Meng and Wu, 2019). Some research highlights a greater emphasis on acquiring ICT skills in high schools compared to primary schools due to the nature of the subjects taught in those schools (Pelgrum, 2001). Additionally, more frequent use of ICT resources is reported in high schools compared to primary schools (Williams, Coles, Wilson, Richardson and Tuson, 2000), as well as a higher level of ICT skills among high school teachers (Almerich, Suárez, Belloch, Gastaldo, Orellana, Bo and Diaz, 2005; Almerich, Orellana, Suárez-Rodríguez and Díaz-García, 2016). Given that high school teachers typically have access to a broader range of resources, access to technology for primary school teachers may outweigh all other factors in ICT use in teaching. However, this should not necessarily be interpreted as a deficiency of inhibiting factors to educational technology implementation, such as teachers' lack of competence (Williams et al., 2000).

In the third model of hierarchical regression analysis, teachers' self-efficacy for ICT use was introduced. This third model explains 29.4% of the variance in ICT use in teaching. Teachers' self-efficacy in the context of ICT is a significant predictor of ICT use in teaching even after controlling for sociodemographic variables and above equipment availability assessment in schools. With an increase in teachers' self-efficacy in the domain of ICT, the frequency of ICT use in teaching also increases. This result is consistent with other research showing that teachers' ICT self-efficacy significantly contributes to and

is positively associated with ICT use in teaching practice. Teachers reporting higher levels of ICT self-efficacy also report greater use of ICT in practice (Baturay, Gökçearslan and Ke, 2017; Tondeur, Petko, Christensen, Drossel, Starkey, Knezek and Schmidt-Crawford, 2020). This result confirms the expectation that the perceived ICT self-efficacy of teachers influences their intention to use ICT for teaching (Hatlevik, 2017; Teo et al., 2008), as well as their perceived use of it (Paraskeva, Bouta and Papagianni, 2008). Perceived self-efficacy has been linked in previous studies to the pedagogical use of technology in teaching (Lee and Lee, 2014), the use of digital learning materials (Kreijns, Vermeulen, Kirschner, Buuren and Acker, 2013), and the creation of materials for online assessment (Ninković, Olić Ninković, Lazarević and Adamov, 2021). This study has allowed us to confirm that teacher characteristics are relevant, as well as ICT infrastructure availability in explaining ICT use (Gil-Flores et al., 2017). Thus, second-order barriers, such as teachers' attitudes, self-perceived competencies, and skills, significantly influence the implementation of technology in teaching (Hämäläinen, Nissinen, Mannonen, Lämsä, Leino and Taajamo, 2021). Consistent with previous research, we conclude that high financial investments in ICT for schools and communities make sense only when there are other factors related to staff and context (Lomos et al., 2023). Furthermore, it should be noted that the higher the school's ICT development, the more prominent the personal factors in enhancing teaching and learning are (Wu, Yu and Hu, 2019). The finding that teachers' ICT self-efficacy and perception of ICT infrastructure contribute to ICT use is consistent with the study conducted by Kundu and associates (2020). Unlike the mentioned study, this research emphasizes the more outstanding predictive contribution of teachers' ICT self-efficacy to the dependent variable.

The practical implications of this study suggest that it is important to create professional development programs for teachers in the field of ICT. According to Bandura (1997), the most potent source of teachers' self-efficacy is mastery experience – achieving goals through personal action. Authors (Morris, Usher and Chen, 2017) state that teacher education is most effective when teachers are allowed to test acquired knowledge and skills in an authentic context. To achieve this goal, teacher training can be team-based (Vanderlinde, Aesaert and Van Braak, 2014), promoting professional collaboration in schools, developing teachers' self-efficacy, and fostering acceptance of constructivist teaching concepts. At the organizational level, it is necessary to allocate time for teacher collaboration, reflection on experiences regarding the use of ICT in teaching and learning, and joint planning of the application of digital learning resources. These measures can impact schools, teachers, and students. A school culture that favors integrating ICT into education, increased teacher competence, and confidence in ICT use results in increased ICT use in classrooms and contributes to improved student motivation, learning, and digital literacy (Gil-Flores et al., 2017). The priority in school should be a shared vision of ICT use and benefits in teaching practice, promoting teachers' self-efficacy and ICT use. Although investing financially in equipping schools with the latest technology is significant, previous research indicates that beliefs about the purpose of technology can compensate for the lack of appropriate equipment in schools (Cheng et al., 2020).

This study has some limitations. It would be significant to include variables within the school environment in the analyses, such as school support or the principal's attitude towards ICT implementation, as well as to consider the perception of other stakeholders in the school. This indicates that broader institutional factors should be included in future studies to provide a more comprehensive view, for example organization management readiness which was attributed of having the highest importance in the implementation of technology in teaching (Štilić, Puška, Puška and Božanić, 2023). When it comes to teachers, it would be relevant in future research to examine teachers' previous experience with ICT both in teaching and in professional development activities, as well as their attitudes and beliefs about the usefulness of ICT use. Additionally, it would be interesting to examine teachers' ICT competency using qualitative methods such as classroom observation. Also, one of the limitations of this study is measuring teachers' ICT self-efficacy as a unidimensional construct, as some authors treat this construct as multidimensional (Hatlevik and Hatlevik, 2018; Scherer and Siddiq, 2015). Finally, rapid technological development necessitates the use of new instruments to assess different aspects of ICT use.

Conclusions

Educational technologies have the potential to significantly enhance student engagement and interest in learning, offering personalized learning environments and timely feedback (Kunter et al., 2013). Therefore, promoting technology-enhanced teaching that moves away from traditional methods is crucial.

Despite students' receptiveness to new technologies, there remains a challenge in how teachers can effectively harness benefits of new technologies. Currently, technology integration in teaching is limited, with frontal teaching methods still predominant, resulting in inadequate teacher-student interaction. In contrast, educational technology allows students to independently progress through the curriculum, track their own advancement, and receive feedback through interactive and multimedia content. Thus, students are better adapted to technologies, while teachers need to have the willingness to use new technologies. This adaptability is crucial for the effective integration of ICT in teaching (Stošić, 2015).

Barriers to ICT implementation in teaching often stem from motivational factors among teachers and access issues related to ICT infrastructure and sociodemographic characteristics. While some countries equip their school systems with ICT infrastructure, actual implementation of digital materials remains sparse, particularly in developing countries where insufficient ICT equipment in schools poses a significant obstacle. ICT self-efficacy, defined as teachers' belief in their ability to teach effectively with ICT, emerges as a critical determinant. Teachers with higher levels of self-efficacy are more inclined to adopt innovative methods and use ICT more frequently. This self-efficacy correlates with perceived ease of use, usefulness, and persistence in the complex process of technology integration.

Hierarchical regression analysis revealed significant predictors of ICT use in teaching. ICT equipment emerged as a predictor even after controlling for sociodemographic variables, indicating its role in facilitating ICT utilization. However, ICT self-efficacy explained a greater proportion of variance in ICT use, underscoring its pivotal role. As teachers' ICT self-efficacy increases, so does their use of ICT in teaching.

In conclusion, while ICT equipment plays an important role in predicting ICT use in teaching, ICT self-efficacy exerts a more substantial influence. This finding highlights the need for further exploration into factors shaping teachers' beliefs regarding ICT integration. It is imperative to provide ongoing training within schools, fostering collaborative environments where teachers can observe and engage in reflective dialogue with colleagues to enhance their self-efficacy. Beyond financial investments in innovative technologies, creating supportive school environments is essential for effective ICT application. Future research should consider additional variables such as teacher attitudes and organizational factors to broaden our understanding of ICT integration in education.

Conflict of interests

The authors declare no conflict of interest.

Author Contributions

M.M. and S.N. made a substantial contribution to the conception and design, as well as to the analysis and interpretation of results. M.M. and S.N. were jointly responsible for drafting and revising the article. All authors have read and agreed to the published version of the manuscript.

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